Tracing Cosmic Evolution with Galaxy Clusters
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Tracing Cosmic Evolution with the Las Campanas Distant Cluster Survey

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Abstract. The Las Campanas Distant Cluster Survey (LCDCS), which contains over 1000 cluster candidates at $z>0.3$, is a unique sample with which to probe the evolution of both cluster galaxies and the properties of the cluster population. Programs are now underway to utilize the LCDCS for both purposes. We provide a brief overview of these programs, and also present new results for the LCDCS cluster correlation function. Utilizing well-defined, approximately dispersion-limited subsamples, we measure the angular correlation function for clusters at $z\approx0.5$. Spatial correlation lengths are then derived via Limber inversion. We find that the correlation length depends upon mass, as parameterized by the mean cluster separation, in a manner that is consistent with both local observations and CDM predictions for the clustering strength at $z=0.5$.

1. Summary

The past few years have been a period of tremendous progress in detection of distant clusters. As recently as five years ago no single survey contained more than ten cluster candidates at $z>0.5$, but a series of efforts have since led to a several order of magnitude increase in the number of known high-redshift systems (Postman et al. 1996, Scodeggio et al. 1999, Gladders & Yee 2001, Gonzalez

et al. 2001). The recently completed Las Campanas Distant Cluster Survey (LCDCS) is our contribution to this field. Clusters in the LCDCS are detected as regions of excess optical surface brightness relative to the background sky, a technique that permits detection of clusters to $z{\approx}0.9$ with shallow, drift-scan imaging. The resulting statistical catalog consists of 1073 cluster candidates at $z{\gtrsim}0.3$. To enable efficient use of these catalogs we use follow-up imaging and spectroscopy to characterize the properties of the sample, including the contamination rate as well as estimates of the redshifts and relative velocity dispersions of the candidates (see Gonzalez et al. 2001*a* for details).

One application of this sample is determination of the cluster correlation function (Gonzalez et al. 2001*b*). For roughly dispersion-limited subsamples at $z{\approx}0.5$ the observed angular correlation functions are well fit by the power law $\omega(\theta) = A_\omega \theta^{1-\gamma}$ with $\gamma = 2.1$. Using the angular correlation data, we derive the spatial correlation length (r_0) as a function of mean intracluster separation (d_c) via the cosmological Limber inversion. We find correlation lengths for the LCDCS that are similar to those observed for local catalogs, and observe a dependence of r_0 upon d_c that is comparable to the results of Croft et al. (1997) for the APM catalog. These results are consistent with theoretical expectations, which predict only modest evolution in the clustering amplitude since $z{=}0.5$.

Several programs are also being conducted with LCDCS clusters to study the evolution of cluster galaxies. Nelson et al. (2001*a*, *b*) are studying the structural and luminosity evolution of BCG's; Nelson et al. (2001*c*) are studying evolution in the luminosity function and color of the red envelope. Meanwhile, the EDisCS collaboration is conducting a deep multicolor imaging and spectroscopic survey of 20 of the most massive LCDCS candidates at $z{=}0.5$ and $z{=}0.8$, with the aim of constraining cluster galaxy morphologies, scaling relations, cluster dynamics, and the evolution of cluster galaxies at these epochs.

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